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Providing decision support using insights from narrative science

David Koelle, Victoria Romero, Noa Palmon, Peter Weyhrauch, James Niehaus, Jonathan Pfautz

Charles River Analytics, 625 Mount Auburn Street, Cambridge, MA 02138, USA

Abstract

Research in narrative science across academia and industry continually uncovers new insights that have relevance to understanding how narratives affect behavior change in regions around the world. These insights are valuable to military decision-makers and analysts who seek to understand how adversaries create and use narratives to alter population behaviors. Unfortunately, the transfer of findings from research institutions to operational settings is often slow, indirect, and fraught with challenges [1]. Research results are most frequently expressed in scientific papers that tend to circulate among researchers, but not with tactical communities. We are developing a technique that facilitates the creation of models that represent the relationships among key research findings by leveraging concepts from user-centered modeling [2] and informed by prior work in model composability [3]. This technique supports the creation of models by researchers as well as operational users. We have uncovered several key insights in our development of this modeling technique. First, qualitative abstract-level summaries of research results are often useful on their own, as they provide descriptive information that can explain key variables and their interactions. Second, the use of well-defined qualitative terms enables a form of composability for summary models, which has the potential to enrich the larger body of research by connecting related findings. Third, the explicit capture of context within the summary models provides a means for recognizing or specifying the conditions under which a research finding may be applicable (e.g., with respect to culture, geographic location, mission objective, or intended audience). Fourth, enriching summary models with the ability to support higher model fidelity (i.e., deeper levels of detail about relationships in the model) allows for the representation of conflicting evidence and conflicting summary models, as well as connection to quantitative data and data-driven models. These summary models, represented as heterogeneous networks, can be used by different types of tactical tools to satisfy a variety of goals, such as analyzing an adversary's narratives, decomposing a specific adversary message, and assessing the physiological response to a narrative. Finally, results from applying research in operational environments can be fed back to the model context and could potentially provide researchers with data on the real-world implementation of concepts from the academic community.

Keywords: Model composition; Narrative science; Cross-cultural models; User-centered modeling; Operationalizing social science

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1. Introduction

Research in narrative science across academia and industry continually uncovers insights that are relevant to understanding how narratives affect behavior change in regions around the world. These insights are valuable to military decision-makers and analysts who seek to understand how adversaries create and use narratives to alter population behaviors, and how analysts can craft messages to respond to conflict, or can introduce narratives to shape regions of conflict.

One example of such an insight is the concept of narrative transportation: the feeling of losing one's surroundings and being inside the story. Narrative transportation heightens a reader's identification with the worldview of story characters, while reducing the salience of the reader's own worldview and identity [4]. A transported audience is less likely to directly counter ideas integral to the storyline of a narrative [5]. Other research on narrative transportation intersects with narrative concepts such as suspense [6], and identifiable characters [7]. Operational communities tasked with both understanding narratives in a region of conflict as well as persuading audiences to engage in new or different behaviors benefit from findings like these. These operators already produce messages with the goal of affecting audiences; using these findings to craft better messages will help increase the likelihood that those messages have the desired effect on audience behavior. We distinguish between narrative as the general discussions and trends within society at large, which we will call "big narrative," and narrative as expressed as messages in specific products such as newspaper articles and videos, which we will call "small narrative." Both are concerns in the operational environment: audiences absorb, respond to, and promulgate the big narrative through the small narrative. It is through the effective use of the small narrative that changes to the big narrative can be made. The purpose of our research is to maximize the effectiveness of small narrative to shift the big narrative, especially for the purpose of shaping conflict regions [8], although these findings are also transferable to other domains, such as public health [9,10] and advertising [11,12].

Unfortunately, the transfer of findings from research institutions to operational settings is often slow, indirect, and fraught with challenges [1]. Research results are frequently expressed in scientific papers that tend to circulate among researchers, but not within tactical communities. Scientific research uses field-specific jargon that is not easily understood by people outside of the research field. Often, research communities that can provide insight to an operational problem might be disparate, so even a self-motivated operator might miss research from adjacent fields with which they are unfamiliar. For example, research on narrative transportation is spread across disciplines including cognitive psychology, cognitive neuroscience, consumer research, marketing, and advertising. The ability to extract and understand concepts from research, connect those concepts to results from related research, capture and represent factors relating to cross-cultural validity of the research, and apply those findings to a relevant operational problem requires an uncommon degree of insight, focus, and time. Operators may also not be as skilled as scientists at extracting the most important information from research articles, parsing the various statistical tests and analyses, and applying experience in understanding the research results' statistical significance and their importance.

To address these challenges, we have developed an approach to represent concepts from narrative science in qualitative models that provide input to user-centered tools to help operational users craft effective narratives. Four key insights provide the basis for our modeling technique. First, qualitative abstract-level summaries of research results are often useful on their own, as they provide descriptive information that can explain key variables and their interactions. Second, the use of well-defined qualitative terms enables a form of composability for summary models, which has the potential to enrich the larger body of research by connecting related findings. Third, the explicit capture of context within the summary models provides a means for recognizing or specifying the conditions under which a research finding may be applicable (e.g., with respect to culture, geographic location, mission objective, or intended audience). Fourth, enriching summary models with the ability to support higher model fidelity (i.e., deeper levels of detail about relationships in the model) allows for the representation of conflicting evidence and conflicting summary models, as well as connection to quantitative data and data-driven models. These summary models, represented as heterogeneous networks, can be used by different tactical tools to satisfy a variety of goals, such as analyzing an adversary's narratives, decomposing a specific adversary message, and assessing the physiological response to a narrative.

2. Qualitative models of narrative science

2.1. Translating empirical research into narrative models

Scientific research describes relationships among concepts, supported by evidence and methodology that support those findings. Our task has been to find a way to represent concepts and relationships from narrative research in a form that allows connections to be drawn across multiple research efforts, and that supports user-centered tools so those findings can guide operational users. We have designed a modeling approach that captures key findings from narrative research: the concepts, the relationships among those concepts, the context in which each relationship was found, and references to the original paper. While our models are intended for use in user-centered tools, they are also succinct representations of concepts from a publication, and can be explored directly by anyone interested in understanding how concepts in narrative science interrelate. This type of model solves a gap that we have seen as researchers involved in both academic environments and operational settings: there is a disconnect between research and the end-user communities who can benefit from that research. For example, in one of the seminal papers in the field, Green and Brock [5] discuss narrative transportation, devise a narrative transportation scale to measure participants' narrative transportation, and describe four experiments in which they further explored the implications of narrative transportation.

The concepts in this paper are enlightening and relevant to operational situations. It is an excellent scientific paper. Unfortunately, there is a low likelihood that the everyday operational user will read a paper like this: they would have to know about the existence of the paper, they would have to be comfortable with the academic language used in the paper, and they would have to understand how the results apply to their specific operational situation. However, if the operators were fortunate enough to engage researchers in a discussion about their work, chances are that researchers would communicate the concepts within their paper differently, and operators may leave the discussion more informed than when they entered it.

Fig. 1. shows a model that we have created based on one of the experiments from Green and Brock's work. In this experiment, participants read "Murder at the Mall", a story in which a college-aged student brought her little sister to the mall, where the little sister was fatally stabbed by a psychiatric patient. Participants were assigned to one of two conditions: half were told the story was fictional, and half were told it was a journalistic account. After reading the story, participants completed several questionnaires, including the Transportation Scale, and one in which they rated different story-specific beliefs (e.g., whether psychiatric patients should be confined to hospitals).

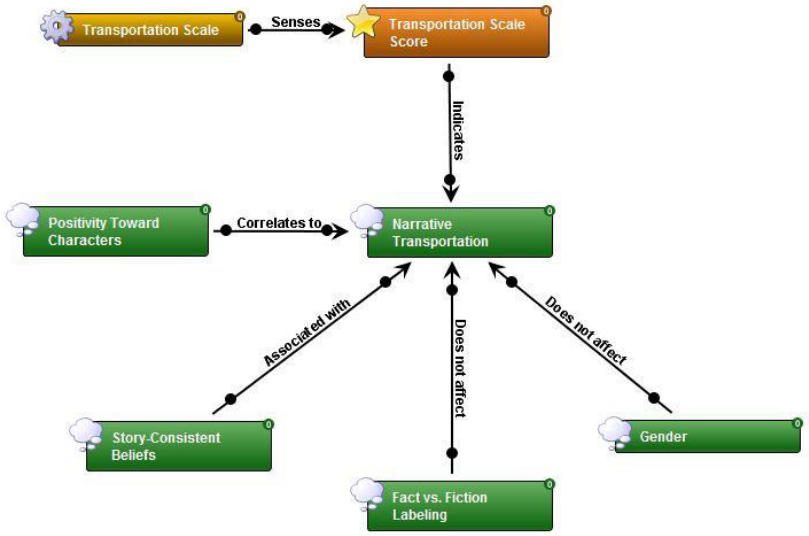

Fig. 2. Qualitative model based on Green and Brock's work on narrative transportation as presented in [5], Experiment 1.

The model that we built shows the relationships among concepts (shown in green), where each concept is a well-defined term that has a definition generally agreed upon by the research community (e.g., "Narrative Transportation"). Relationships between concepts can indicate various degrees of causation or correlation, and are backed by both statistical results and the context under which the research was conducted (as discussed in Section 3, this helps address issues with cross-cultural applicability of research results). Additional types of nodes and relationships, described more fully in Section 3, provide for expressiveness outside of concepts alone.

2.2. Combining models with similar concepts

Green and Brock [5] focus on narrative transportation. Having done a deep review of the literature, we find that narrative transportation is directly related to another concept, narrative persuasion [7,13]. We have created models for each of those papers, and we assert that as long as each paper uses the same clear definition of a concept such as narrative persuasion, these models can be combined on that well-defined term. In fact, this is similar to how researchers might write a review-style paper (see [14] for an excellent review paper on narrative transportation). Combining models on well-defined terms results in models that allow for drawing reasonable conclusions based on multiple papers. We have been colloquially calling this combination of models a "megamodel." Our megamodel of narrative research currently includes research from a wide range of empirical articles; it also includes operational insights that operators have developed through their work in the field (e.g. insights about the motivation behind specific belligerent groups such as ISIS). The composition of models is similar to a review paper but is automated in its construction. It allows for the inclusion or exclusion of individual models (perhaps based on trust in the underlying research, trust in the model builder, or applicability of the research to a specific operational need), and provides end-to-end relationships between concepts that might otherwise be spread across multiple publications, domains, and research efforts.

In conceiving of this idea of combining models, we considered the many challenges of model composability (e.g., as described by Davis and Anderson [3]). We believe that using well-defined terms as the joint between qualitative models is a reasonable approach to relating work from multiple publications. Furthermore, by incorporating details about the context under which each relationship has been validated, we provide a mechanism for operators to assess the applicability of a particular result with respect to an operational setting rather than making it appear that the result is true for all purposes. Our goal in creating the "megamodel" is to dramatically increase the literacy of operators and their tools to the findings of narrative science, including insight into when, how, and whether to apply any set of findings.

3. Detailed features of qualitative models

3.1. Categories of narrative elements

Through our review of publications on narrative science, we identified categories of items that the papers commonly discussed, and we encoded these as entity types in our model representation. This allows us to create instances of a category with a specific name—for example, "narrative transportation" is a concept. These categories are as follows:

- *Sensor*: a device capable of making a measurement, usually of human state (e.g., functional magnetic resonance imaging (fMRI), functional near-infrared spectroscopy (fNIRS))
- *Measure:* the result of an assessment using a sensor or a survey (e.g., oxygenated blood flow to the brain)
- *Concept:* an idea from research (e.g., narrative transportation, need for affect, intergroup empathy)
- *Neurophysiological State:* activation in a brain region (e.g., right superior temporal gyrus), usually one that is activated as a function of a concept, or indicates the occurrence of a concept
- *Guidance:* a method for evoking a concept (e.g., "use the first-person voice") that provides a specific way that the concept is evoked or evidenced through messages
- *Consequence:* the behavioral result of a concept (e.g., a change in world view, donation behavior)

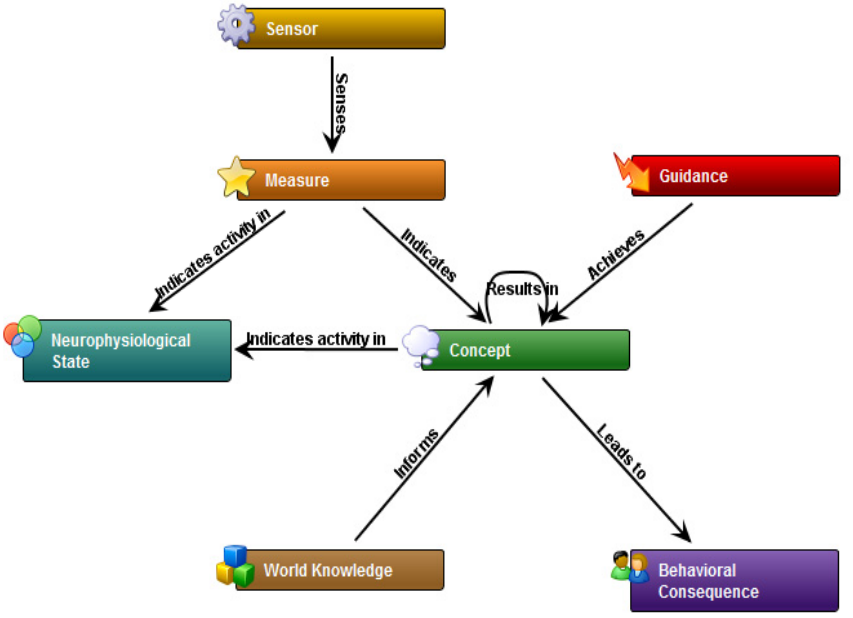

Fig. 2. Types of nodes and links in our model.

- *World Knowledge:* Known facts about the world, often historical, that have a clear influence on the behavior of audiences and could affect the application of narrative concepts but are not themselves elements of narrative (e.g., a culture's attitude towards pride in one's nationality)

3.2. Relationships between categories

We also identified the ways in which categories relate to each other. Our links are limited to the types of categories they connect; for example, while a concept might "increase activity in" a neurophysiological state, that same link is not available between a sensor and a measure. For some relationships, there is a very limited set of link types (for example, sensors can only be linked to measures, and only through a "senses" link type). For others, especially between concepts, there is a larger set of link types that capture the range of relationships we discovered while conducting our review. We found that in many cases, relationships between concepts was a broad statement that two concepts are related, or that one affects another, without specific data to support that relationship, so we have the very broad "is related to" and "leads to" links (the former does not indicate that one concept actually follows the other), and a broad correlation relationships ("correlates to"). We also have more specific, but still numerically ambiguous states of "increases" and "decreases" (and, with respect to the relationship between concepts and neurophysiological state, "increases activity in," "decreases activity in," and "correlates to activity in"). We also have a link type that is used to specifically express a relationship that has been disproven "does not affect." This may seem odd at first, since one could surmise that any relationship that is not expressed must by default be because two concepts are uncorrelated, but we created this link type to express research that specifically shows that two concepts are not correlated; in our investigation, this may be done to dispel common assumptions.

When combined in the "megamodel," relationships between elements within individual models are maintained. In addition to the benefit of seeing all related concepts in one place, this also means that the combined model could have relationships that appear to conflict. For example, out of the four experiments conducted by Green and Brock [5], two found significantly higher narrative transportation in women, while the other two found no relation between gender and transportation. We could create a valid model for each of these experiments; see Figure 1, which models one of the experiments in which no relationship was found between gender and transportation, for an example. When these models are combined, the resulting model will have both "does not affect" and "is related to" relationships

between gender and transportation. We stress that this is not a problem. Each relationship reflects the literature, and each relationship will have additional context that will be useful in identifying the specific conditions under which the finding is true. Each relationship will also have a link to the original publication. Tools that use these models (see Section 5) need to be aware of these types of relationships.

3.3. Representing the context of empirical relationships

For each relationship, we represent the context under which the relationship was found to be true. For our narrative science models, we established the following context categories:

- *Participants:* attributes of the experiment's sample population (e.g., number of participants, age (range or average), gender, location, language)
- *Methods:* the experimental circumstances under which the relationship was found to be true (e.g., experimental condition, number of trials, trial duration, experimental environment)
- *Stimulus:* attributes of the narrative stimulus presented in the experiment, both narrative (e.g., narrator, narrative elements, themes) and otherwise (e.g., medium (audiovisual, visual), language, duration, themes).
- *Analysis:* quantitative findings, including descriptive statistics (e.g., mean, standard deviation) and statistical test values (e.g., p-value, correlation coefficient)

Explicitly capturing the original context provides a means for recognizing and specifying the conditions under which research was conducted, which informs the conditions in which the research finding may be applicable in the future, and suggests whether the model may be useful in cross-cultural applications. Context is captured along various axes, including audience, geographic location, objectives, media types, statistical analysis, and narrative information.

Context is essential for making the summary models usable in operational contexts, and operational tools may present the context to operators so they consider whether the model is relevant to their application. they consider whether the model is relevant to their application. An operator may use a research-based model's context to compare the conditions and underlying assumptions between the model's research environment and their own operational environment.

4. Validation of narrative models

There are several issues of validity that must be addressed when creating and evaluating these models. The first set of validity concerns relate to the modeling formalism itself:

1. *Representational validity:* Is the network representation of qualitative models the correct representation for the information from scientific research? Can complex semantic structures be adequately represented (e.g., "*X* is true if *Y* is *y*, or *Z* is *z* but not both;" "*X* and *Y* are both necessary for *Z* to be true")?
2. *Category and relationship validity:* Does our selection of categories and relationships listed under Section 3 provide the right level of resolution for representing concepts from the literature?

The next set of validity concerns are related to the identification of research that will be turned into models:

3. *Selection validity:* Is the set of research results that have been selected for inclusion sufficiently broad and unbiased? Are the criteria for selection of research results clearly articulated?
4. *Scientific validity:* How can we assess the quality of the research underlying our models? Will users who receive results from the model have the necessary information and skill set to assess the validity of the underlying research?

The next set of validity concerns are related to the creation of models from scientific research:

5. *Construction validity:* Who created the model? Is the model an accurate representation of the research? Who validates the translation of research to model? What happens if the model builder discovers logical errors in the research?
6. *Context validity:* Has the model builder sufficiently represented the context in which the findings are true?

The final set of validity concerns relate to the operational use of the models:

7. *Operational relevance:* Are the models operationally relevant? Do they provide insight that is useful in addressing operational issues?
8. *Operational utility:* Do the tools that use the models search the models effectively? Do they present information from the models in an accurate way and suggest relevant ways to apply knowledge from the models to operational settings?

We continue to examine these issues of validity and mitigate the risks associated with them as we develop and demonstrate prototype products to the research community, to experts in industry (e.g., marketing and advertising), and to operational users. An important next step in refining our models includes cross-cultural validation, which requires replicating and extending these research studies in foreign populations of interest.

5. Model-based tools for narrative creation and assessment

One of the primary goals in our effort is the development of a user-centered tool that maximizes operators' effectiveness in creating "small narrative" products. The tool integrates with an existing system that operators use to describe their objectives, geographic region, audiences they plan to persuade, and media available in the region. The tool uses this information to search the "megamodel" to find relevant concepts and relationships, and it returns a ranked list of advice, based on the guidance elements in the combined model, to the operator. This list appears next to the area where operators describe the product and its narrative. Operators can then highlight portions of their text and associate them with the advice that guided them to writing that section by clicking a box next to the advice. Like comments in common document editing software, operators can select a highlighted portion of text and see what advice is associated with it; and, they can select a piece of advice and see which portions of the text address the advice.

Operators can discover more information about each piece of advice (see Figure 3); the details provide information about which parts of the search query matched the result, and a snippet of the relevant relationships from the combined models. We have also designed the ability for the details to show other operations where the model was used. A further development goal includes adding operational effectiveness to the models' context, allowing future uses of the models to see which concepts and relationships worked (or did not work) in which types of operational settings.

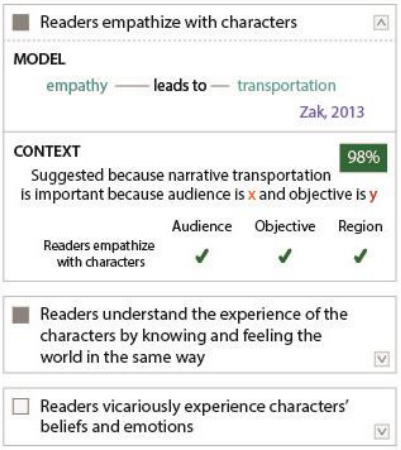

Fig. 3. Advice shown to operators.

5.1. Operator feedback

We had the opportunity to engage an operational community with our model concept and a prototype narrative authoring tool that uses the models to provide guidance in crafting products. At this point, our evaluations have been formative rather than summative, although we look forward to more exacting evaluations in the future. Feedback from operators has been universally positive. Other researchers and industry experts (e.g., advertising executives) have also expressed credibility in our approach, notwithstanding the validity concerns expressed earlier.

6. Conclusion

We believe that qualitative models of narrative research, and user-centered tools that make use of those models, provide a compelling addition to operational tools for crafting narrative products. The composition of qualitative models seems to be a novel approach to addressing some of the issues with model composability, and at the same time such models provide insight to operational users that they would not otherwise have.

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